

# **Report to Congress**

## **Status of Low Emission Boiler System (LEBS)**

### **Phase IV**

#### **Proof-of-Concept (POC) Facility**

**U.S. Department of Energy  
Assistant Secretary for Fossil Energy  
Office of Coal and Power Systems**

**January 1999  
Report to Congress  
Status of Low Emission Boiler System (LEBS)**

**Phase IV  
Proof-of-Concept (POC) Facility  
Prairie Energy Project  
January 1999**

**Background**

Congress has provided continued appropriations now totaling approximately \$31 million in support of Phase IV of the Low Emission Boiler System (LEBS). The principal feature of Phase IV is construction of a proof-of-concept facility currently sited in Elkhart, Illinois. This report is in response to the Conference Report to accompany H.R. 4328 (Making Omnibus Consolidated and Emergency Supplemental Appropriations for FY 1999) which stated:

“It is critical to the continuation of the Low Emission Boiler Program that the State of Illinois provide its full cost-share of \$25 million. The Department should report to the Committees by January 31, 1999, on the status of the Low Emission Boiler Program including whether or not the full cost-share has been received from the State of Illinois, the extent to which the project is feasible from the standpoint of bids received from contractors for the project construction and the extent to which purchase agreements have been arranged.” (H. R. Report No. 105-825, 105<sup>th</sup> Congress, 2<sup>nd</sup> Session, p 1228 (1998)).

**State of Illinois Funding**

As of mid-January 1999, \$3 million of the \$25 million full Illinois cost-share has been appropriated. The State of Illinois supports this project. In a letter dated June 9, 1998, (attached) Director Norm Sims of the Illinois Department of Commerce and Community Affairs discusses the process the State will use to fulfill its financial commitment. The State has authorized \$25.2 million in coal development bonds for the project and is committed to providing the remaining \$22 million necessary to complete this project. The State of Illinois will take up this matter in the 1999 legislative session.

**Project Construction Bids**

Sargent & Lundy, the owner’s engineering firm, reported that construction specifications were released for bid as scheduled on January 7, 1999. Formal bids are due on April 2, 1999. The project participants have indicated that pre-bid conferences with bidders continue to indicate the project is feasible. Sargent & Lundy has prepared an internal project estimated cost. This estimated cost establishes a baseline for comparison and will

be used by the Prairie Energy Project team to evaluate bids received. It also allows the participants to authenticate the financial feasibility of the project given the amounts of funding expected from each of the sources—the Department of Energy, the State of Illinois, the project team, and lenders.

### **Power Purchase Agreements**

The participants have indicated that several conditional letter agreements regarding the purchase of the full power output from the Prairie Energy Project have been received. Prospective purchasers include independent power producers and development arms of U.S. based Fortune 500 electric utilities. The project team is currently negotiating with prospective power purchasers, but is not able to divulge any details due to the confidential nature of these proceedings. The participants expect negotiations to be completed by April 1999, at which time the results will be made public.

### **LEBS Program Description**

LEBS is one of the highly advanced power systems under development via a government-industry partnership. As compared to coal-fired power plants that constitute the bulk of our domestic power generation system, LEBS offers a significantly higher thermal efficiency, superior environmental performance, and a lower cost of electricity. Among the advanced power systems currently under development, LEBS is the closest to entering the commercial market. LEBS is expected to be available for commercial applications in 2002.

The LEBS program, initiated in 1992 by three industry teams, has four phases. Phase 1, completed in 1994, included technical and economic evaluations of candidate plant subsystems, a systems analysis of the entire power plant, and the preliminary design of a commercial-scale, 400 MWe LEBS plant. In Phase II three industry teams continued engineering analysis and modeling activities and conducting experimental testing of plant subsystems at scales of approximately 3-10 MWe. Phase III produced site-specific designs for proof-of-concept test facilities, 10-80 MWe in size, and updated commercial plant designs and economics based on Phase II results. At the end of Phase III in 1997, DOE selected one team from competitive proposals, that is, DB Riley, Inc., to continue on to Phase IV. Phase IV, the final portion of the program, includes detailed design, construction, and operation of a proof-of-concept facility.

### **LEBS Technology**

Significant technical advances have been made in the LEBS program. Low nitrogen oxide (NO<sub>x</sub>), U-fired, slagging combustion systems and a regenerable flue gas cleanup system employing copper oxide sorbents were tested in Phases II and III.

Slagging combustors produce granulated slag instead of fly ash. This reduces the amount of solid waste handling since slag has a specific volume of about one-third to one-half that of fly ash. Slag also reduces ground pollution because it is resistant to leaching. Approximately 50 commercial U-fired, slagging boilers have been constructed and operated world-wide, but NO<sub>x</sub> emissions from these units are high due to the high operating temperatures. In the DB Riley Research Center, tests of the combustion system demonstrated NO<sub>x</sub> emissions less than 0.2 pound per million Btu, four to nine times lower than the NO<sub>x</sub> emissions of 0.8-1.8 pounds per million Btu produced by older burners.

DB Riley, Sargent & Lundy and ThermoPower Corporation are evaluating a moving-bed copper oxide process for removing both SO<sub>2</sub> and NO<sub>x</sub> from the flue gas. Recently, a 1 MW moving bed copper oxide pilot plant was constructed and tested at the Illinois Coal Development Park in Carbondale, Illinois. Test results showed over 99% SO<sub>2</sub> removal and over 95% NO<sub>x</sub> removal from the flue gas.

#### **LEBS Proof-of-Concept Plant**

The proposed LEBS proof-of-concept plant is a new 86 MWe plant to be located at the Turrill Coal Company's mine near Springfield, Illinois. This proof-of-concept plant is a test unit for the 400 MWe commercial generating unit design. After the test program is completed, the plant is to operate as a source of independent power and will serve as a showcase for LEBS technology.

Regarding the moving bed copper oxide process a 10 MWe equivalent test module will be constructed at an Illinois site. This scale-up testing should validate the viability of the process.

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**Project Participants**

The project participants are:

<b>Participants</b>	<b>Role</b>
DB Riley, Inc. - Worcester, MA	Prime contractor, boiler and firing systems supplier
Sargent & Lundy, LLC – Chicago, IL	Conceptual plant design, participants' engineer, environmental permit engineering and copper oxide flue gas clean-up system design
Turris Coal Company – Elkhart, IL	Host site, coal supplier, ash disposal services, and wastewater discharge service
ThermoPower Corporation - Waltham, MA	Copper oxide flue gas cleanup process design
Reaction Engineering International/University of Utah - Salt Lake City, Utah	Combustion system modeling and design support
Illinois Dept. of Commerce and Community Affairs	Co-sponsor
Illinois Clean Coal Institute	Copper oxide test facility site
U.S. Department of Energy	Co-sponsor and oversight

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**Project Funding Source**

The estimated cost of the Prairie Energy Project is \$127 million. The sources of funding are shown below:

<b>Funding Source</b>	<b>Funding Status</b>	<b>Amount (\$ million)</b>
USDOE		
	Received	\$ 31
	Anticipated	3
State of Illinois		
	Received	3
	Anticipated	22
Private Financing		
Participants' Equity	Committed	18
Lender Debt	To be arranged	50
<b>Total</b>		<b>\$ 127</b>

**Status of Private Financing**

The project requires private debt financing of \$50 million. A financial business plan is in preparation and will be released to lenders in February 1999. Responses from lenders are anticipated in time to have a loan commitment by June 1999. Project financing is expected to be complete by October 1999.

**Summary**

Via a competitive process Phase IV of the Department's Low Emission Boiler System program began with the selection of a team lead by DB Riley. Their Prairie Energy Project meets the greater than 50% cost sharing criteria. The Prairie Energy Project continues to make significant progress and is continuing as scheduled. As of the end of January 1999, the major barrier to the project moving forward is funding of \$22 million from the State of Illinois. The State of Illinois budget for fiscal year 2000 will be known by the end of May 1999. The participants' current expectations are that construction of the proof-of-concept facility will be initiated before the end of 1999.